Vireya Taxonomy in Field and Laboratory

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Since the second International Rhododendron Conference in May 1982 considerable additional living materials have been added to our collections in Edinburgh from fieldwork by myself and colleagues. Several more field trips to Sabah have, perhaps reassuringly, confirmed most of the taxonomy as it has been presented in the manuscript "Rhododendrons of Sabah" which was reported 'in press' (Argent 1985) and has unfortunately still not been produced although there has been a limited circulation of the manuscript. One new species from S.E. Kalimantan has just been described: *Rhododendron alborugosum* Argent & Dransfield is an attractive white flowered species with contrasting red pedicels. This has no close affinities; it represents a parallel with *R.suaveolens* Sleum. from Sabah but this is one of only superficial similarity. It keys out in Sleumer (1966) amongst a group of solenovireyas but again the similarities are those of parallel evolution and it is most doubtful if there is any close relationship. Another possible new species was discovered in the region of Long Pasia in S.W. Sabah but living materials have failed to survive and it still awaits a detailed analysis and hopefully a further re-collection. *R.lanceolatum* Ridley was found again here, a species only newly recorded to Sabah and of rather restricted distribution in the north of Sarawak and just over the border in Kalimantan. Some of the old problems remain and if anything have become further complicated with the collection of new material. This is certainly so with the boundary between *R.brookeanum* Low ex Lindl. and *R.javanicum* (Bl.) Benn. These species have been unified in the Sabah handbook but within Borneo it now looks as if a distinction can be made between them. We have recently flowered material from Bukit Silam in E. Sabah at Edinburgh which shows remarkable similarity to the Javan form of *R.javanicum* and is very distinct from most other forms of *R.brookeanum* in

Sabah, but acquisition of new materials from Sumatra throws back all the old problems of making distinctions of more than one character that do not have exceptions in wide ranging low altitude species.

Other problems remain amongst the very scaly malayovireyas. A specimen of *R.durionifolium* Becc. from Sarawak with very large flowers has been known to me for a long time and proved very puzzling. What was quite extraordinary was to find in a Podzol forest near Long Pasia a population of *R.durionifolium* with three quite distinct flower sizes growing together in close proximity. A similar population has also been recorded from Bario in N. Sarawak by Mr. A. Lamb. These size classes remain an enigma and the failure to root cuttings of the three forms from Long Pasia means that we cannot hope to study this problem in the laboratory at least for the present.

A major expedition to the island of Seram by Operation Raleigh in 1987 allowed four weeks intensive field work to be undertaken relatively painlessly as we were helicoptered in to Kanikeh village at the foot of Gunong Binaia, courtesy of the Indonesian Army. We were housed in an extensive if not palatial camp built by the local villagers and venturers of Operation Raleigh and provided with guides from Kanikeh and helpers of various nationalities. Seram is the next large island to the west of New Guinea and like it has a chain of mountains running east-west. Gunong Binaia at approximately 3000m is the highest peak on the island and although more than 1000m lower than the high peaks of New Guinea is a significant mountain with open alpine-type vegetation on the summit. Ericaceous shrubbery or tree fern forests are developed on many of the ridges and this merges into mossy rain forest at about 1500m. The summit is more open than one might expect in such a wet equatorial climate but the mountain is of very porous limestone and is heavily grazed by apparently introduced deer. At Kanikeh itself the vegetation was one of disturbed rainforest as there was considerable evidence of past agriculture on a more extensive scale than was at present being practised. Sleumer (1966) records only 6 species of *Rhododendron* from Seram and if the island of Buru is included it is still only 9. A very low number compared

with the 157 (now 167) for New Guinea but quite respectable to any of the major islands in comparison to land area.

In the submontane rain forest two species occurred close to the Kanikeh camp. One of these was only seen vegetative and is being cultivated but still awaits identification, the other was *R.zoelleri* Warb. with its orange and yellow flowers growing mostly as an epiphyte high in forest trees and normally only seen as fallen corollas. The one specimen collected differs from typical New Guinean plants in having much smaller anthers, a condition that Sleumer (1966) notes occurs at the south-eastern end of the range in the Central and Milne Bay Districts of Papua New Guinea. In the moss forest at at least 2000m *R.malayanum* Jack var. *pilosifilum* Sleum. occurred in some quantity. This form of *R.malayanum* is now in cultivation in Edinburgh where it is hoped that its status can be re-evaluated in comparison to *R.malayanum* from other areas. It is certainly quite distinct in the finely hairy pedicels that Sleumer (1966) describes. Perhaps the most notable find in the same area as *R.malayanum* was that of *R.bagobonum* Copel.f. This species was first described from Mindanao in the Philippines, then turned up in Borneo and was found to be of widespread occurrence there (Fig.1). This record for Seram is however new and a considerable extension to the range of this curious species. *R.bagobonum* is very uniform in its morphology and at least as far as Bornean material now cultivated in Edinburgh for several years appears to be habitually self-pollinated, the stigma growing through the mass of viscin threads and pollen at the mouth of flower. This may be one strategy for success in a species which is very economical with its floral dressing. Because it is a small flowered species often growing in the canopy of tall trees it is easily overlooked and may well turn up in the intervening islands of Halmahera and Sulawesi. One other plant of note which turned up in the moss forest was a large flowered pink species collected by my colleague Ian Edwards. This was first thought to be a hybrid between *R.ruttenii* J.J. Smith a tubular white flowered species from higher up the mountain and perhaps the *R.malayanum* which was abundant in this area. The scales however appear

to show little evidence of *Malayovireya* parentage and the pink flowers of this beautiful plant are larger than either of the prospective parents.

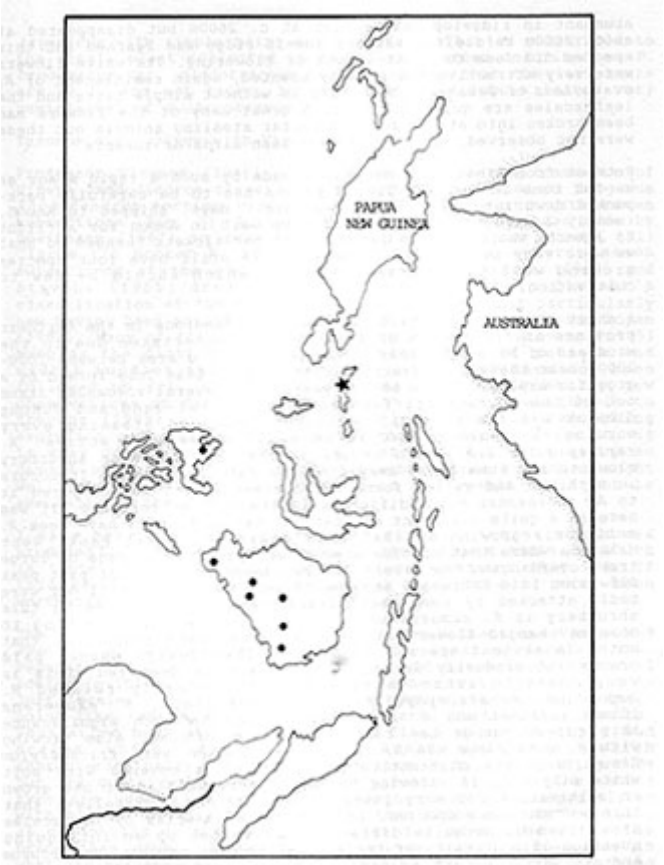


Figure 1.

Distribution of *Rhododendron bagobonum* Copel. F. Dots represent old records, the star a new record for Seram.

Higher up Gunong Binaia a *Pseudovireya* became quite common although it did not seem to be at the height of its flowering but several flowers were found after a great deal of searching. It turned out to be *R.meliphagidum* J.J.Smith, a plant named after the honey eater *Meliphaga stigmatops deningeri*which it was said to be one of its favourite flowers (Smith 1932). This species originally collected by E. Stresemann on Mt. Togha, Buru was described as having brownish-orange flowers but the later collection of Rutten on Seram from G. Moerkele (G. Binaia's eastern neighbour), had yellow flowers as did all the plants seen on G. Binaia. This species is obviously closely related to the *R.quadrasianum* Vidal complex and appears from the very limited observation to go in for the same dual colour forms as are known from *R.borneense* (J.J.Smith) Argent, Lamb & Phillips in Sarawak. What is slightly

surprising is that a montane species with such a long corolla tube (c. 3cm long) should become fixed on yellow as a flower colour in Seram. This long tube would seem a very difficult shape for pollinating insects, which could see yellow easily but would be relatively inconspicuous to birds who could cope better with this shape. We were obviously out of season in September and saw no visitors to the four flowers which were out. *R.ruttenii* has already been mentioned. It became abundant in ridgetop shrubberies at c. 2600m but disappeared at about 2800m before the exposed summit ridge was reached and this species did seem to be at a peak of flowering, its white flowers were very attractive and sweetly scented, again reminiscent of *R.suaveolens* of Sabah but the ovary is without simple hairs and the leaf scales are quite distinct. A great many of the flowers had been broken into at the base by nectar stealing animals but these were not observed, they could have been birds or insects.

Retreat from Binaia was not to be made by such a rapid means as we had come in and the living plants had to be carefully back-packed down into the lowland heat for 3 days, shipped to Ambon, (nearly 2 days), then another 2 days wait in Ambon for a flight to Jakarta where we were lucky to get our tickets changed so that we were swiftly off to Britain. We still have four species growing well from Seram, three of which should be new to cultivation.

A short visit to Sumatra to look at Rhododendrons in the northern province in the region of Brestagi was undertaken due to the kindness of Mr. J.M. Comber. This is a plateau area between 1000 - 2000m near the very attractive crater lake, Lake Toba formed by a gigantic explosion some 60,000 years B.C. Several volcanoes stand out of the surrounding fertile agricultural land and Gunong Sibayak was the closest, standing clear and steaming every morning, a reminder that it is still considered active. *R.rarilepidotum* J.J. Smith occurs in the open hillside shrubbery close to the summit but away from the sulphurous vent. It occurs in both red and yellow forms and Sleumer (1966) has compared it to *R.robinsonii* Ridl. differing in the smaller corollas. It was here in a quite different habitat to that in which I have seen *R.robinsonii*

growing in the Taman Negara National Park, West Malaysia where that species grew as an epiphyte in shade of large trees overhanging the rivers. *R.rarilepidotum* was just past peak flowering (mid February) and the flowers that were still out were badly attacked by some small lepidoptera. Also growing in this shrubbery is *R.sumatranum* Merr. which it was interesting to observe changed flower colour in a manner very similar to that noted in several species in Borneo. The flowers opened pale orange and gradually darkened with age to a deep red. This is very characteristic in Borneo of the closely related *R.bagobonum, R.stenophyllum* Hook. f. ex Stapf., *R.exuberans* (Sleum.) Argent and *R.nervulosum* Sleum. How much significance this colour change has taxonomically is unclear. Also growing with *R.sumatranum* was *R.retusum* (Bl.) Benn. var. *trichostylum* Sleum. with its distinctive narrow corollas covered with soft white simple hairs. Knowing the Javan form well as it has grown in cultivation for many years I found it hard to believe that this was the same species. Limited S.E.M. samples of the scales shows them to be quite different and throws up an intriguing question of conformity of the species concept between *R.retusum* and its varieties and *R.buxoides* Sleum. from N. Sarawak. A neat little plant from swampy forests at lower altitude was *R.pubigermen* J.J. Smith. It grew with the very common *R.sessilifolium* J.J. Smith and an odd form of what is apparently *R.javanicum*with simple hairs on the leaves. This is comparable to the single plant collected in central E. Borneo described as *R.brookeanum* var. *cladotrichum* Sleum. except that the leaf hairs are white and not brown, but the plant has rugose leaves very reminiscent of *R.brookeanum*.

Taxonomic groupings with Vireya.

Professor Sleumer (1966) has provided the modern framework of Vireya Rhododendron classification with the division of Subgenus *Rhododendron* section *Vireya* (Blume) H.F. Copeland into seven subsections. (Fig.2). Little advance seems to have been made by Spethmann (1987) in reverting to Clarke's Subgenus *Vireya* (Bl.) Clarke (in Hooker F. 1882) whilst retaining Sleumer's seven subsections at the same rank unaltered. Both Argent (1985) and Stevens (1985) drew attention to anomalies in Sleumer's classification at

the series level but this was not particularly new having been pointed out by Woods (1978) and Kores & van Royen (1982). Many of the 'new' characters suggested by Stevens (1985) such as the distribution of sclereids, shape of petiole and midrib bundles and nodal vascular structure have not been followed up yet, we have a good deal of rather motley new observations on different species. While very sympathetic to Stevens (1985) apparent aim of a classification reflecting evolution and entirely in agreement that we are far from it, it is very possible that we will not attain this in a group so devoid of absolute barriers to interbreeding. Evolution might well have had a reticulate course and the result would not be amendable to the classic dendrogram.

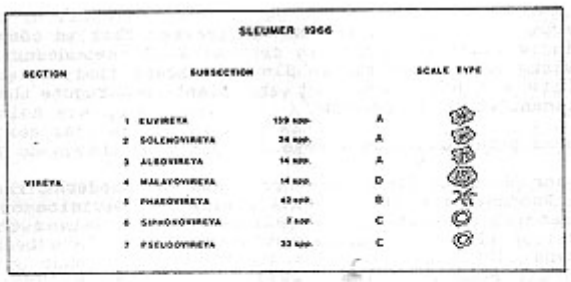


Figure 2.
Classification of *Rhododendron* section *Vireya* after Sleumer 1966.

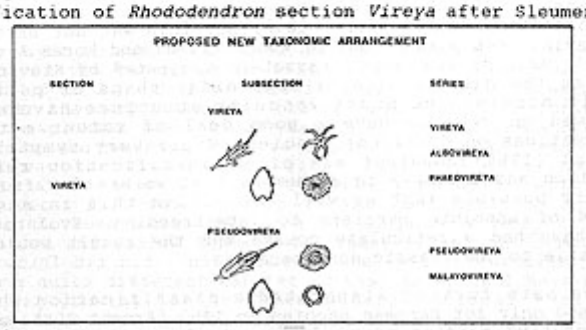
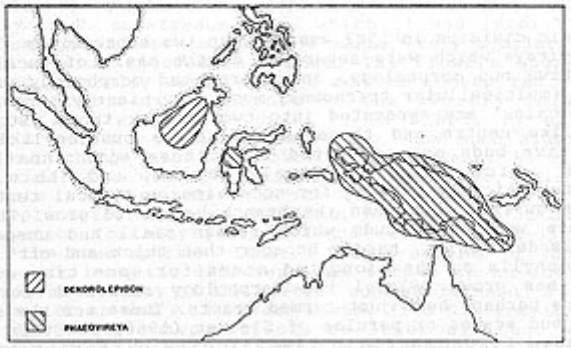


Figure 3.
Proposed new classified of *Rhododendron* section *Vireya*.



Extended distribution of *Phaeovireya*. *Dendrolepidon* A.L. & P. *Phaeovireya* (Clark) Sleum.

I have here further elaborated a classification which was proposed only for Bornean species in 1982 (Argent 1985) and which is tentative pending many additional observations (Fig.3). If this merely stimulates more careful work it will have been worthwhile.

The basic division in 1982 was between two subsections *Vireya* and *Pseudovireya* which were separated on the basis of 'scale' type, vegetative bud morphology, and floral bud morphology. Epidermal scales (multicellular trichomes) most conveniently referred to as just 'scales' are separated into two groups, those with a small point-like centre and those with a large cushion-like centre. Vegetative buds are separated into those with sheathing bud scales which are relatively broad and thin, which characteristically persist for some time on typical resting buds but are quickly shed when the branch begins to grow. The second type are vegetative buds which remain small and unspecialised with slender scales, hardly broader than thick and often persist as catophylls on the elongated stems for some time after the branch has grown. Floral bud morphology showed differences in what are perhaps best just termed bracts. These are the sheathing flower bud scales or perulae of Sleumer (1966) but this term has been used by Chamberlain (1982) quite differently for the vegetative bud scales at the base of elongating branches and although correct in both usages it is confusing and is best dropped.

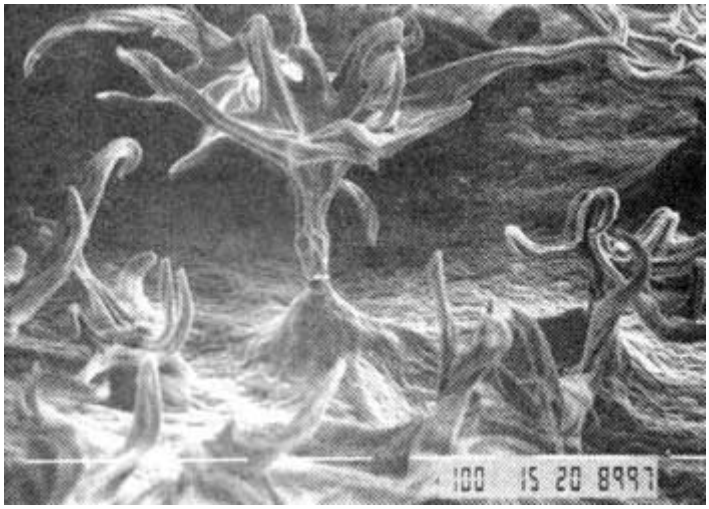
Similarly, with the multicellular hairs being universally called scales, it does not seem common sense to use this term again for totally different structures. In the first subsection the bracts are rarely scaly except at the edges and rarely have simple hairs which if they do occur, rarely form a fringe at the edge. In the second subsection the bracts are almost always fringed with simple hairs and are often very scaly as well. An additional character which seems to correlate with those already mentioned is the way the fruit splits. In the first group the outer coat (exocarp) peels irregularly from the woody 'valves' (meso and endocarps) before the split whereas in the second group there is no such separation, the exocarp remaining firmly attached to the underlying tissues.

These four characters although observed in each case for a relatively small number of species seem to correlate well although there are some notable exceptions. For instance *R.stapfianum* Hemsl. ex Prain has bracts fringed with simple hairs but since this species is highly distinctive in its general covering of simple hairs it is not really so disturbing; *R.variolosum* Becc. in contrast is not fringed with simple hairs and this perhaps lends weight to Sleumer's (1966) supposition that this species might be of hybrid origin; *R.herzogii* Warb. sheds the exocarp from its fruit as the capsule splits which is not what was required of a neat and tidy division but again may indicate hybrid origin generally. The characters described above however are correlated and divide *Vireya* species into two groups. In extending this to the whole section *Vireya* subsection *Vireya* would now include Sleumer's subsections: *Vireya, Albovireya, Phaeovireya* and *Solenovireya* and subsection *Pseudovireya* would include Sleumer's subsections *Pseudovireya, Malayovireya* and *Siphonovireya*. The old subsections can be redesignated series with the exceptions of the long tubular-white flowered groups *Solenovireya* which are included under *Vireya* and *Siphonovireya* which is included under series *Pseudovireya* (Fig.2). Series *Phaeovireya* best incorporates series *Dendrolepidon* Argent, Lamb & Phillips (Fig.4), as the differences between this and *Phaeovireya* Sleumer is whether the scales sit on epidermal protuberances or not. It will be interesting to see if other lines of work support the basic similarity of the West Malesian species with dendroid scales to the largely Papuasian *Phaeovireya* of Sleumer or whether they just represent parallel evolution. Stevens (1985) may well be right that *Phaeovireya* Sleum. represents a monophyletic group in which case the West Malesian *Dendrolepidon* should be excluded as a separate taxon.

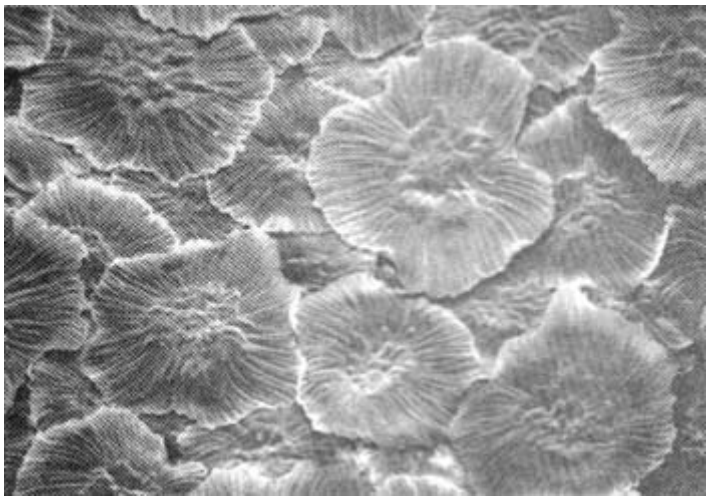
The main reason for rejecting the groups *Solenovireya* and *Siphonovireya* are that they are largely based on corolla shape and that this is considered a very plastic character in evolutionary terms. The long salver-shaped corollas have almost certainly evolved more than once (Stevens 1985) and the general impression is that this type of corolla can evolve relatively rapidly as it is under strong selective control by the different pollinating classes of animals.

However we know very little about the function of scales. It has been variously suggested that the scales accumulate tannins and are repellent to herbivores, reflect light and thus protect plant growth and that they are concerned with the water relations of the plant. The great variation in both numbers and structure of scales suggest that they have evolved along different lines of functionality and in fact may have more than one function. Thus the dendroid scales of *Phaeovireya* are often at first silvery-white and reflective before becoming brown and the dense covering of the interlocking arms must give substantial protection to the young cells of the developing leaf. As the leaf grows the scales become very unstable and quickly disappear more or less completely from the upper surface, thus allowing full penetration of light to the mature tissues. It is quite possible that the young indumentum apart from reflecting light also acts as a deterrent to herbivores. Not necessarily directly inhibiting browsing but by inhibiting Lepidoptera from laying eggs on such an unstable and spiky surface. In fact Dr. J. Holloway (Pers. Comm.) states that few *Lepidoptera* do in fact attack *Rhododendron* leaves in the montane regions of S.E. Asia. Thus the scales might either be considered highly efficient or irrelevant from this point of view. Mention has already been made of the microlepidoptera attack on the flowers of *R.rarilepidotum*, such attacks on *Vireya* flowers are quite common, that *R.rarilepidotum* was badly attacked may reflect the paucity and small size of its scales.

Another aspect of the dendroid scales is that they have many of the characteristics of floccose tomenta which are so common amongst montane plants and which it is thought function both as insulators from cold but more pertinently to restrict water loss from too rapidly warmed leaves whose supply is restricted by low temperatures at the roots. This needs a great deal of physiological investigation.



R.phaeochitum: leaf scale on epidermal tubercle.

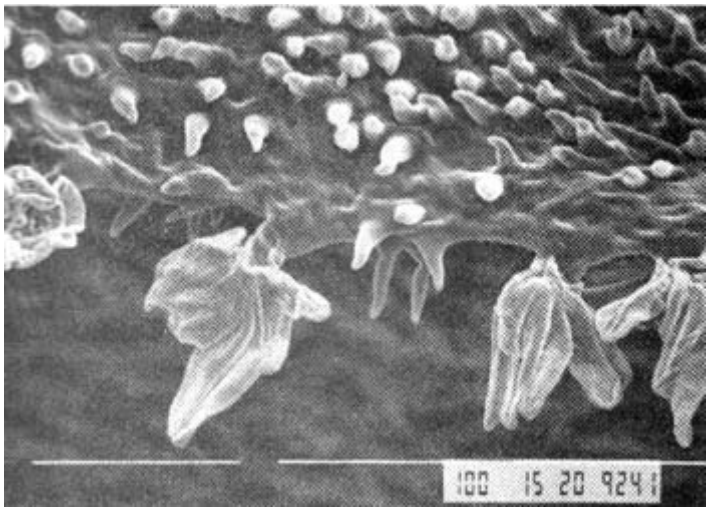


R.malayanum: leaf scales.

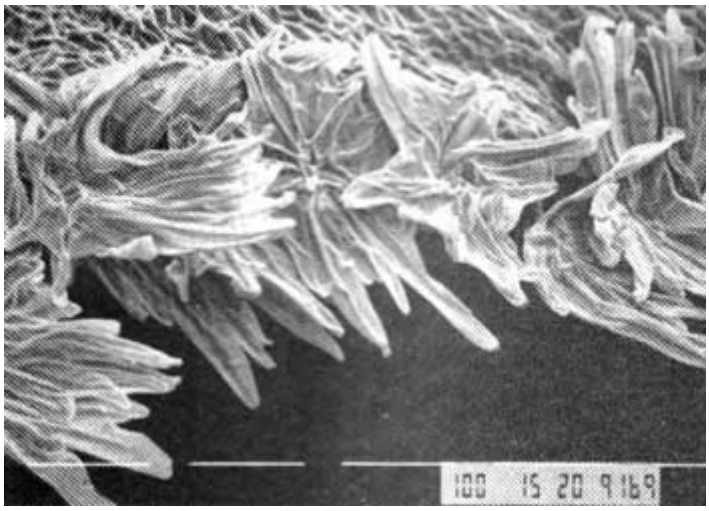
With regard to water relations, comparisons have been drawn to the epidermal scales found on *Bromeliaceae* (Argent 1988) where they materially aid water absorption and restrict loss (Benzing 1976). This does not seem to occur in the same manner in *Vireya*. Most Vireya scales seem to be water repellent and probably play an important part in keeping the lower leaf surface clear of water and help to prevent waterlogging of the stomata. From this point of view it is interesting to note that in some species the scales appear to have a 'repellent' effect on stomates such that there is an area devoid of stomata in the immediate vicinity of the scale. This can be seen for example in *R.pubigermen, R.bagobonum* and *R.santapauii* Sastry, Kataki, Cox, Cox & Hutchison. Other species appear to be neutral in this respect as are *R.armitii* F.M. Bailey, *R.gaultherifolium* J.J. Smith, *R.goodenoughii* Sleum. and as

might be expected all the very scaly *Albovireya* and *Malayovireya* species which have been looked at where the stomata are virtually forced to be under scales. Of the very scaly species *R.durionifolium* is interesting in showing very different scale properties between the upper and lower surfaces of the leaf. This species has a fairly persistent tomentum of silvery scales with dark chocolate brown centres on the upper surface of the leaf and dry leaves are very pale and reflective. If water is dropped into this surface the droplet flattens within a minute as water is absorbed by the scales and the water spreads further beyond the droplet boundary but under the scales as it fills the air spaces above the epidermis. This can easily be seen if a little water soluble dye is added. In practise this exclusion of air turns the leaves from silvery colour to green and presumably facilitates more direct transmission of light to the chlorophyll in the palisade tissue when the leaves are wet. The under surface of the leaf by comparison is highly water repellent, a droplet placed on the scales remaining high sided and showing no evidence of absorption even when left for ten minutes, here the scales may even serve to reflect light which has passed through the body of the leaf back into the palisade from below in addition to repelling water. What is so perplexing about trying to find functions for the scales is the apparent lack of correlation between scale types and ecological niche. Again *R.malayanum* comes to mind as one of the scaliest species that occurs in different but equally scaly forms from almost sea level close to 3000m. Some correlation between altitude and density of tomentum might be found amongst forms with dendroid scales but it is not very obvious; certainly Series *Pseudovireya* with stalked scales appear to occur at high altitude and in exposed places.

This speculative discussion may seem to have little to do with classification but we need to understand the functional aspects of morphology if true weight is to be given to supposedly conservative organs. We certainly need more field observation on the behaviour of populations of different Vireyas and it is always nice to have additional species of such attractive and interesting plants in cultivation.



R.citrinum: bract margin with dorsal papillae and marginal scales.



R.rarum: bract margin with lobed scales.

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